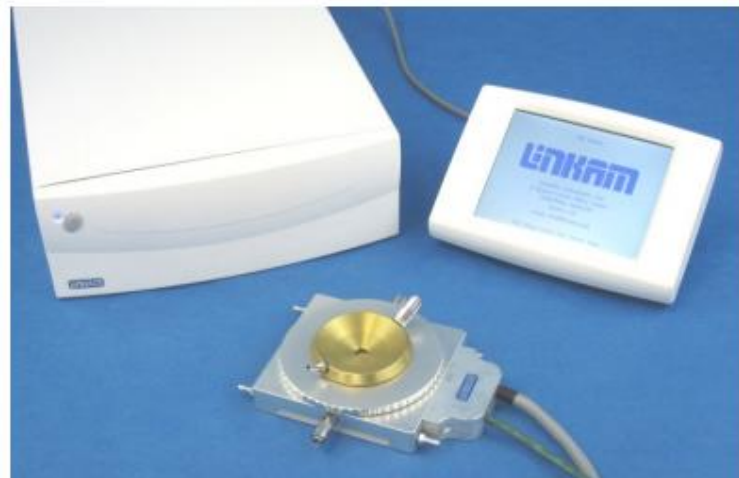


General Guide to the Linkam TS1500 Stages

APS Detector/Equipment Pool

Table of Contents

- Quick Guide
- Safety and Handling
- TS1500 Connections and Parts
- Water Cooling for Stage Body
- Software Controls



Reference: much of the information in this guide is gleaned from User Manuals provided by Linkam with purchase of equipment. If more information is needed, please contact Detector Pool staff at 2-9493 or dp@aps.anl.gov.

The Linkam TS1500 stage can be used to heat a sample from room temperature to 1500°C at speeds of 1-150°C per minute. The Detector Pool has one older stage as well as a newer stage with an updated controller/power supply design. Please note that the TS1500 stage cannot be used to cool a sample.

Safety & Handling

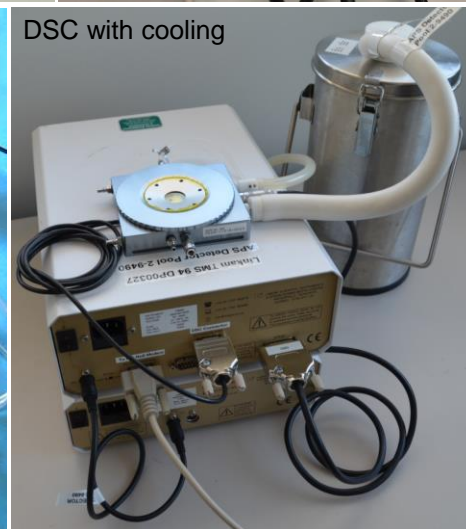
- Linkam stages have **EXTREMELY** fragile platinum leads; please do not touch or move.
- When heating above 300°C, stages require water cooling. Contact DP staff (2-9490).
- Regarding gas purging:
 - Do not use hydrogen or helium (thermal conductivity)
 - Dilute any reactive gases with 95% inert gas
 - Use only mixtures containing less than 20% oxygen
 - Flow less than 60 CC/min
- If using LN2 sample cooling, please follow all APS procedures for safe handling of LN2.



- The black capillary tube on the LN2 dewar lid is fragile; please handle carefully.
- Disconnect the LN2 dewar from the stage before heating above 300°C.

Hardware Operation

- Make all connections

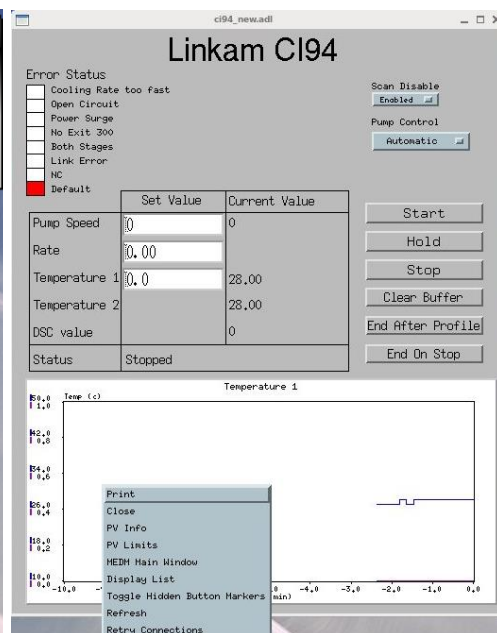
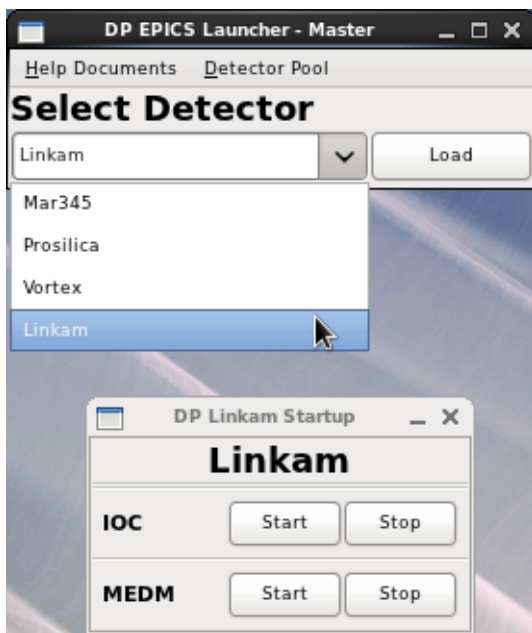


- If cooling sample with LN2:
 - Fill the dewar approximately 2/3 full.
 - The LNP95 must be switched on before the T95/CI95 system controller.
 - The stage chamber needs to be purged of air before starting a cooling experiment.

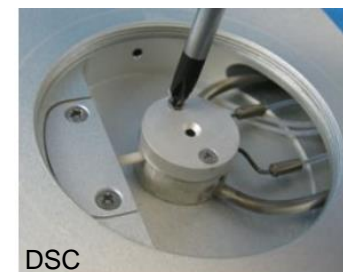
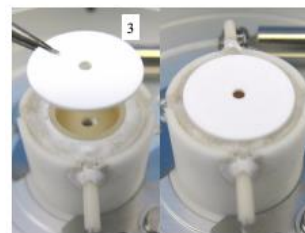
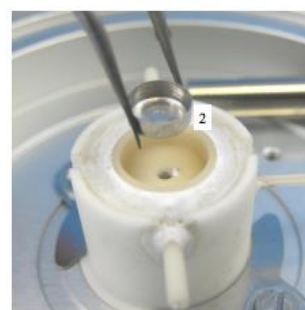
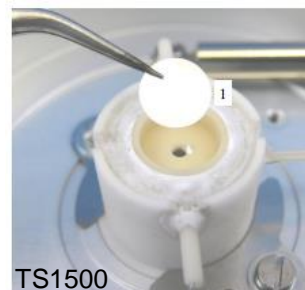
Quick Guide - 2

Software Operation

- Turn on the computer, and log in
 - Username = dpuser
 - Contact DP staff for the password
 - Or, use the sector's LDAP account
- The start-up screen (lower left) will appear
 - Select “Linkam” from the dropdown menu
 - Click “Start” to start the IOC and medm
- Use the EPICS control screen (lower right) to set rate ($^{\circ}\text{C}/\text{min}$) and desired temperature.
 - Pump speed is generally set to “Automatic.”
 - To adjust the y-axis on the strip chart display, right-click, then select “PV Limits.”



Sample Loading

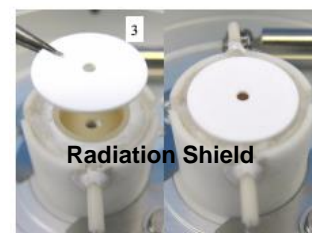
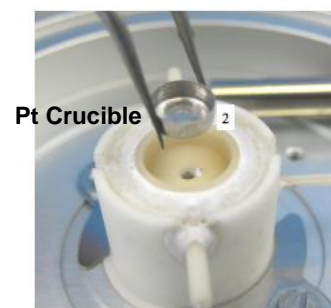
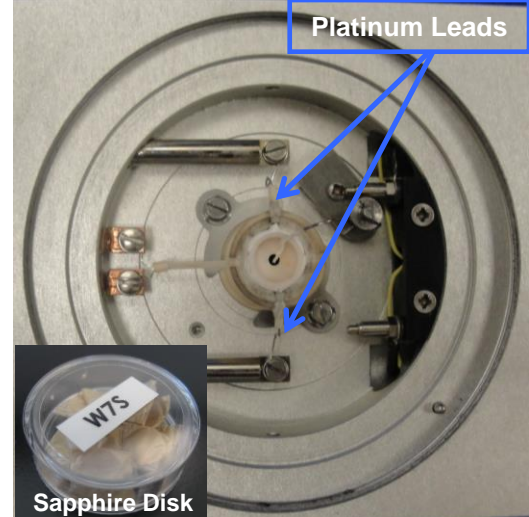


Aluminium and sapphire crucibles

Tzero Press, often used with DSC

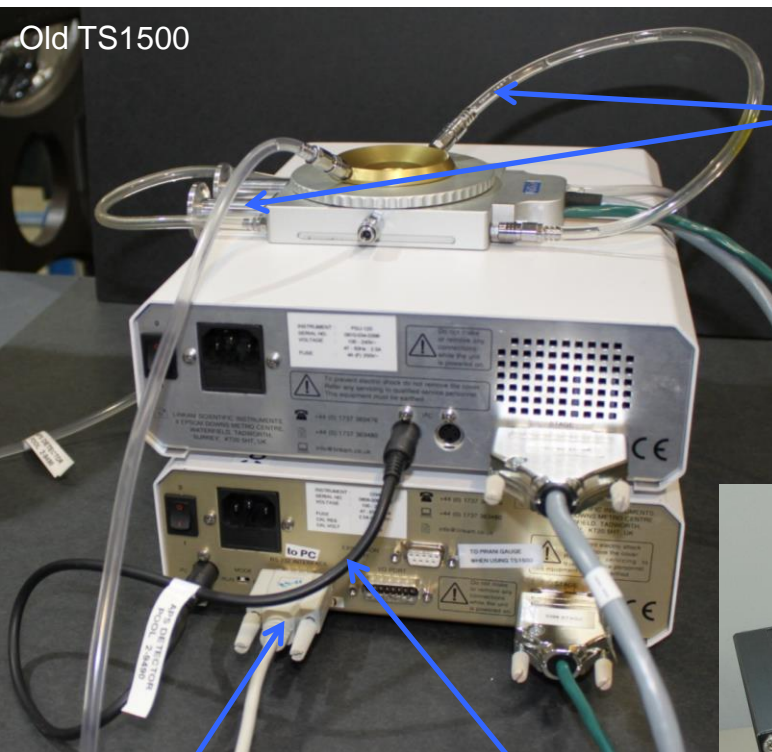
Safety and Handling

- **The heating element is fragile**, especially its platinum leads. Exercise care when loading and unloading samples.
- Use as little sample as possible to reduce thermal load and avoid damaging the heating element.
 - Total mass of sample + carrier < 120mg
- Samples must be placed on either the W7S sapphire disk or a Pt crucible.
 - Otherwise, the sample will fuse to the ceramic cup and damage the thermocouple.
 - The radiation shield (3: lower right) prevents condensation onto the quartz window and helps to ensure uniform heating.
- To prolong the life of the heating element, try to avoid consistently high heating rates and temperatures, as well as quick cycling.
- Heating over 300°C
 - Stages require **water cooling** when heated above 300°C. Contact DP staff (2-9490 or dp@aps.anl.gov) if you were not provided with a water circulator.
- Regarding gas purging:
 - Do not use hydrogen or helium (due to high thermal conductivity)
 - Do not use a gas mixture containing more than 20% oxygen
 - Dilute any reactive gases with 95% inert gas such as nitrogen or argon
 - Use a gas flow of less than 60 CC/min to avoid overloading the heating element
- Failure to observe these guidelines may result in heating element failure.
 - ***If you plan to use the stage in a manner not recommended above, please purchase your own heating element.***



Connections for TS1500, old and new

Old TS1500

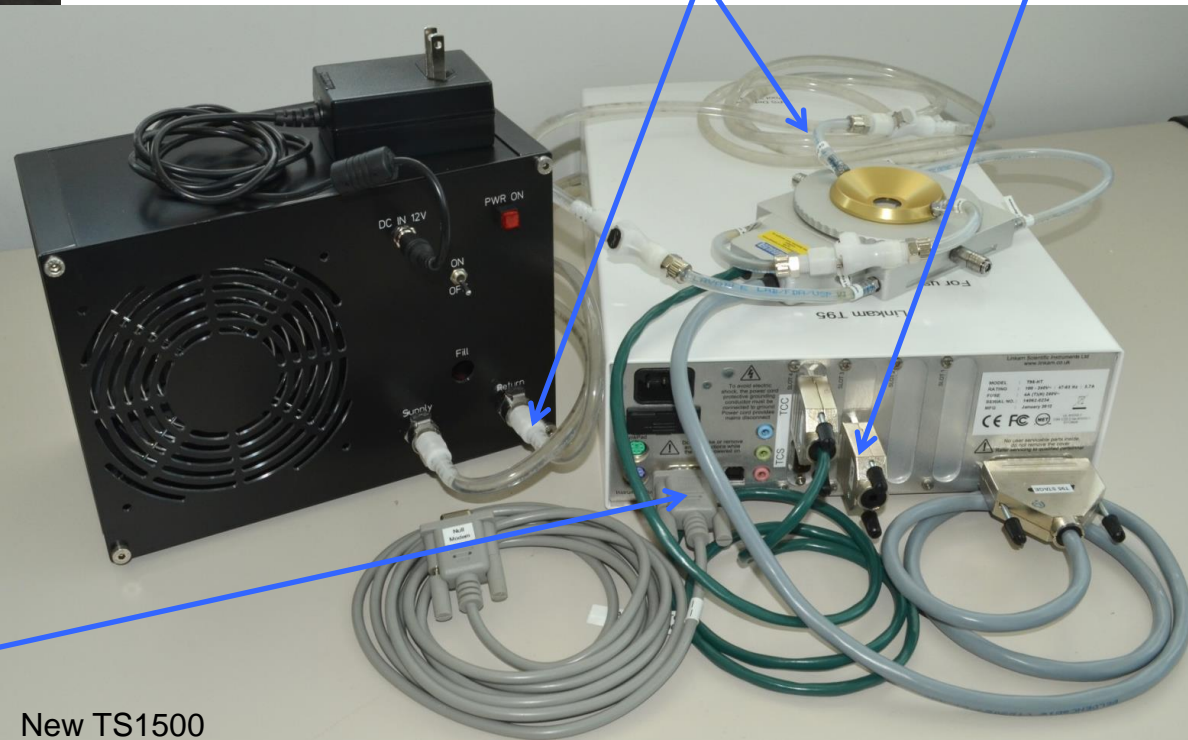


Connections for water cooling

**Crossover/null
modem cable
connects to
computer serial port**

I²C cable connects PSU to CI94

**Crossover/null
modem cable
connects to
computer serial port**



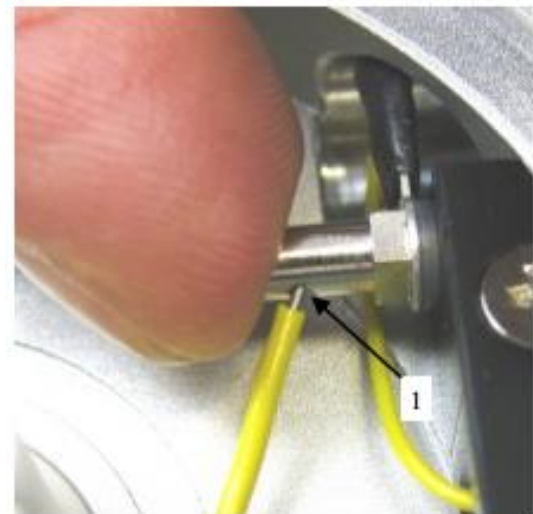
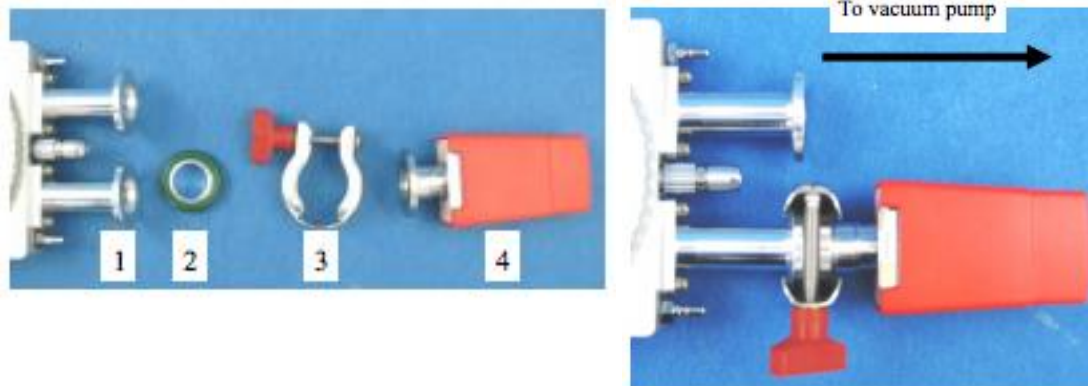
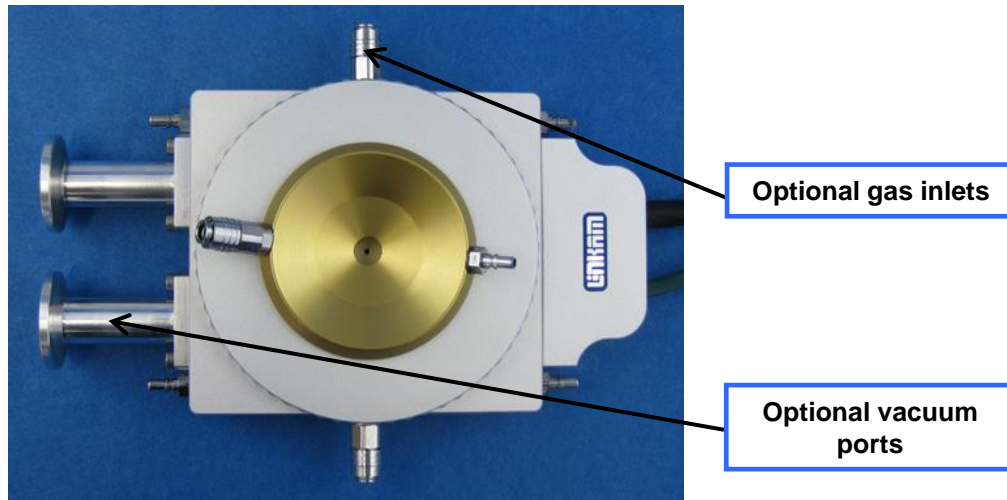
Connections for water cooling

**Vacuum Simulation
Plug (must be in
place when Pirani
Gauge is not in use)**

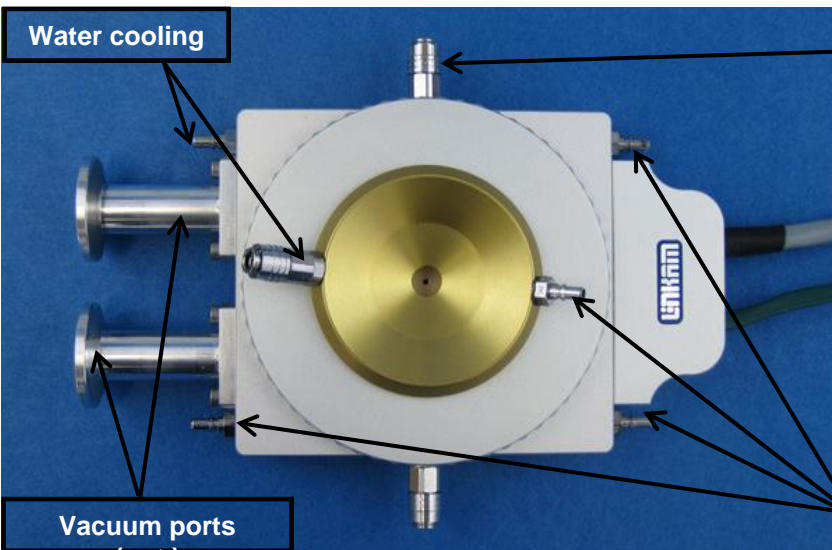
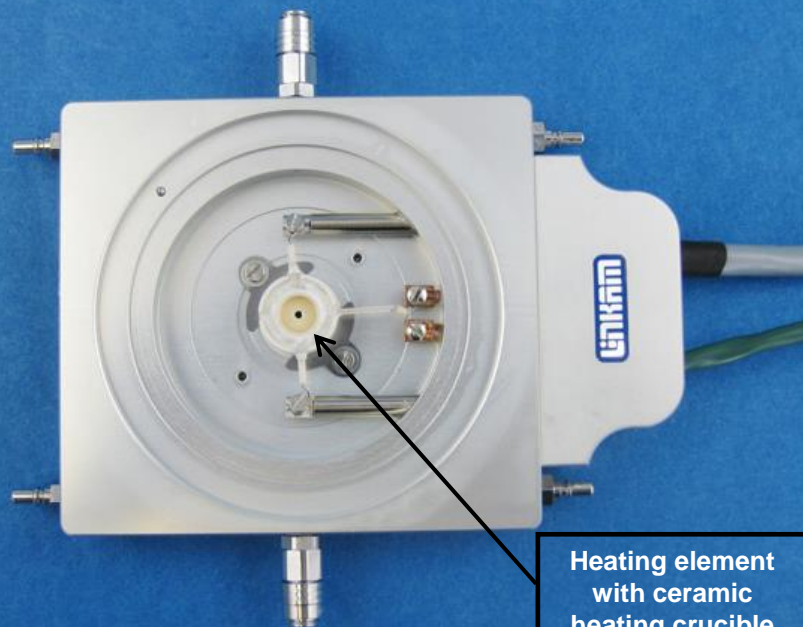
New TS1500

Vacuum and Electrical Connections (optional)

- The vacuum connections should be used if the sample outgases significantly. This will help prevent the deposition of the sample on the interior of the stage.
- Inert gas may also be supplied to aid in purging the sample chamber.
 - Helium is not recommended because of its high thermal conductivity.
- The internal electrical contact has a self-closing spring loaded pin (3).
- Using a finger tip, push in the pin to open the electrical contact and insert a platinum wire into the contact (1).
- Release the finger when the wire is in place.

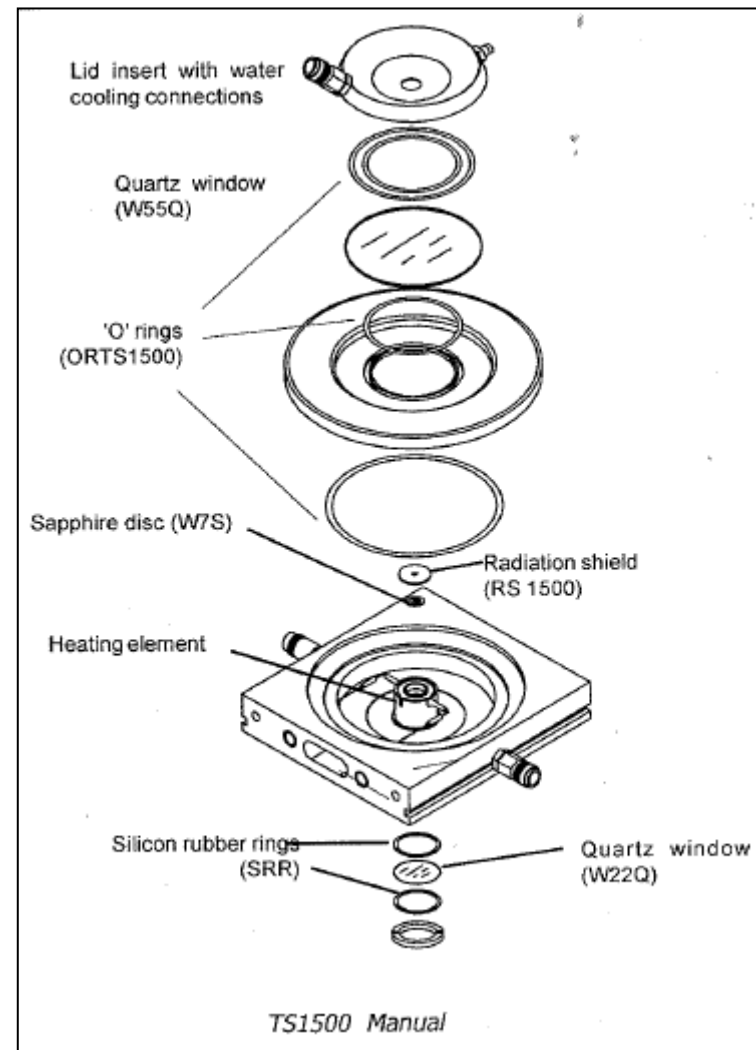


TS1500 Parts

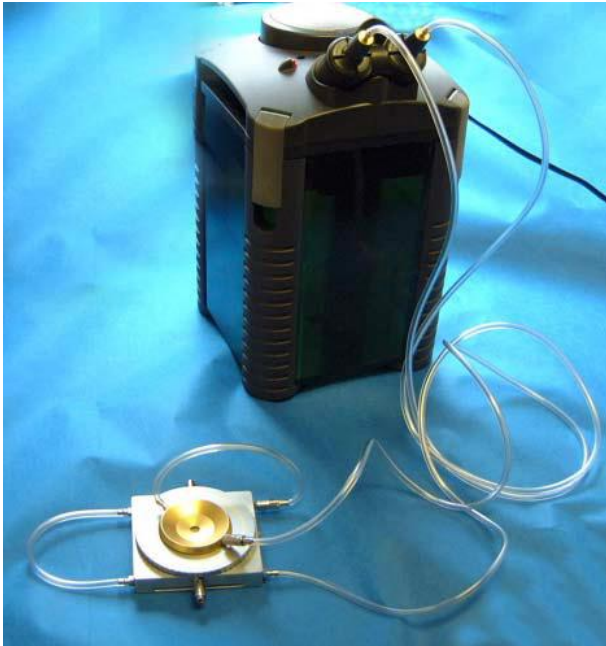


Optional Gas connections

Water cooling connections



Water Cooling Connections

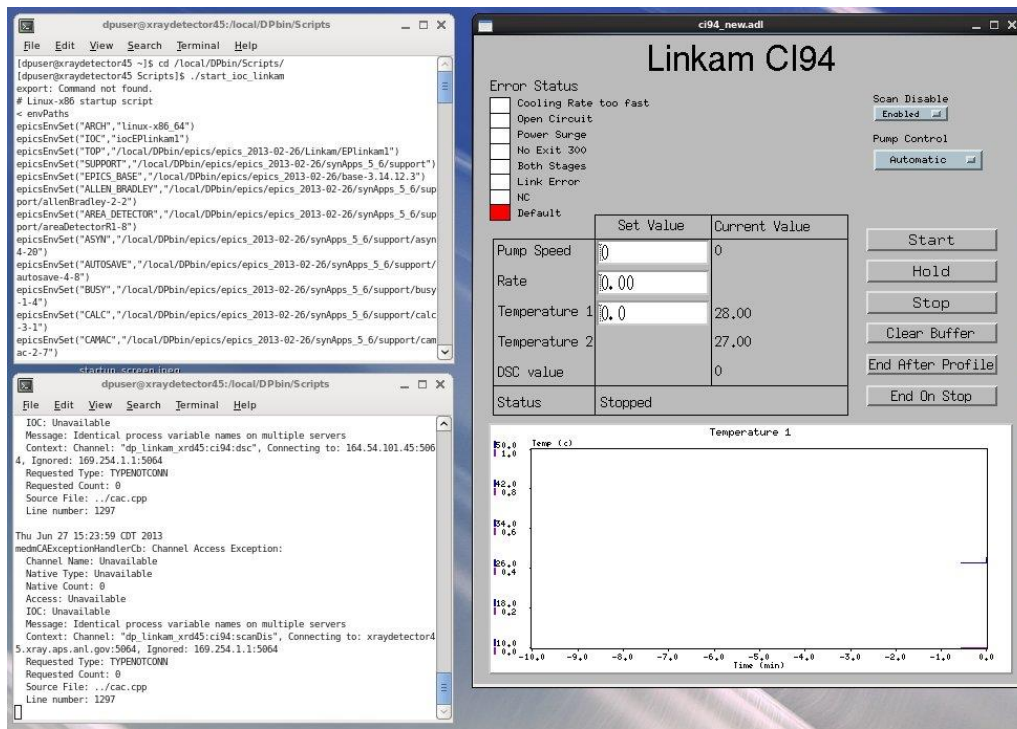


- When heating above 300°C, stages require water cooling to keep the stage body and lid cool. Contact DP staff (2-9490; dp@aps.anl.gov) for a water circulator.
- There are several options for cooling:
 - Linkam ECP Water Circulating Pump
 - It may be necessary to prime the ECP if the water connectors have been removed.
 - DP circulating pump with custom housing
 - To ensure proper circulation, be careful to avoid introducing air into the system. While connecting and disconnecting, take care to prevent water from leaking out.
 - Beamlines may use their own small, recirculating chiller. (less than 20CC/min flow rate)



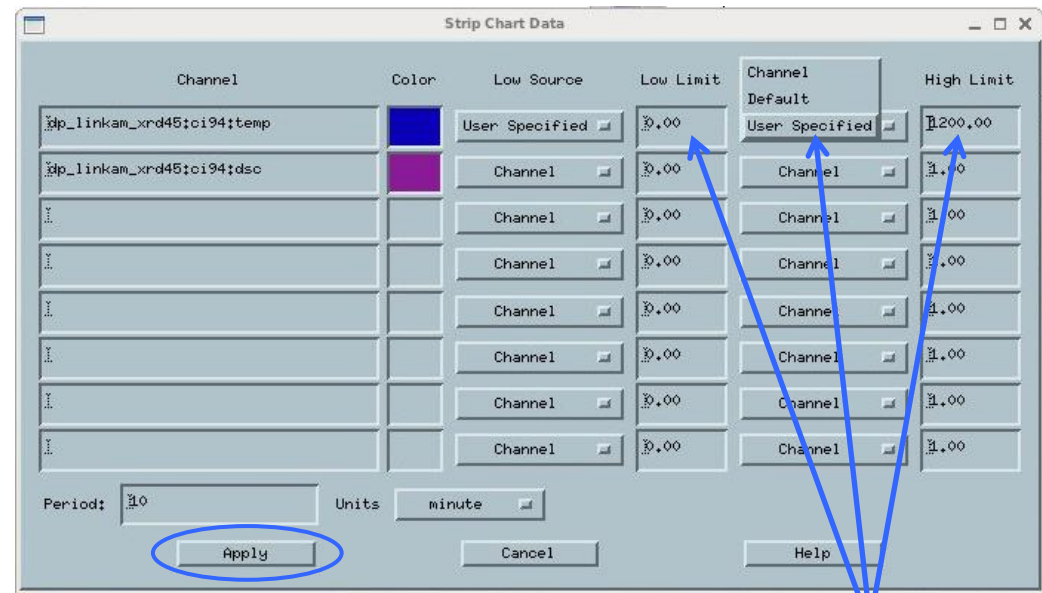
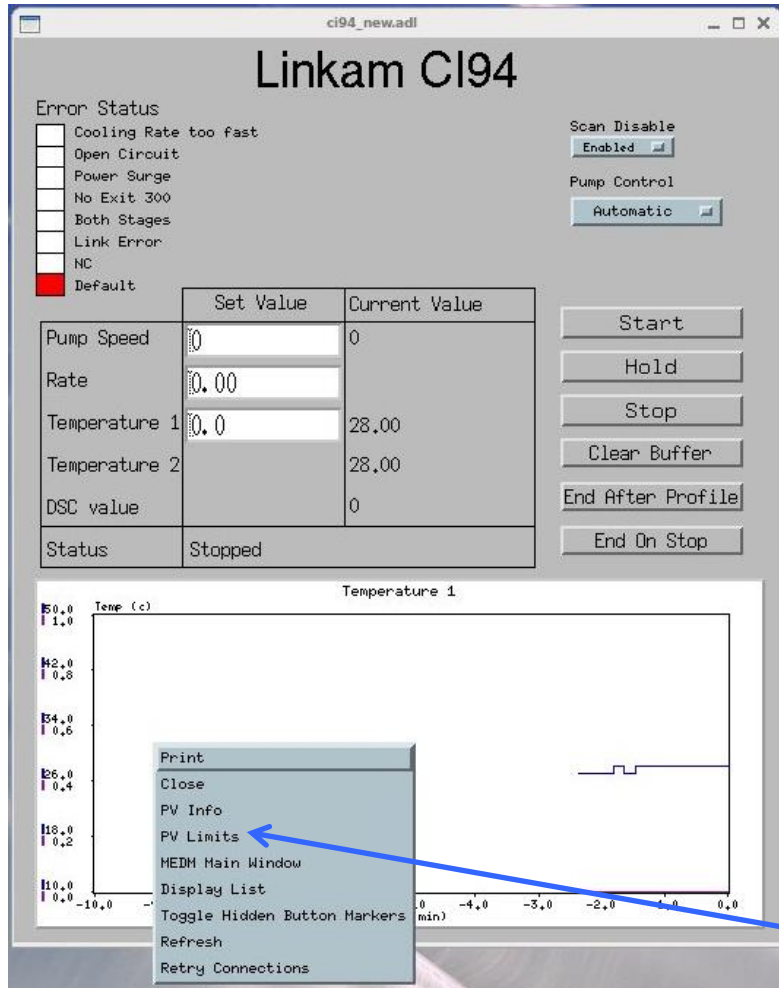
EPICS Software Controls

- Turn on the computer, and log in.
 - Username = dpuser
 - Contact DP staff for the password
 - Or, use the sector's LDAP account (see beamline personnel)
- The start-up screen (shown right) will appear.
 - Select "Linkam" from the dropdown menu
 - Click "Start" to start the IOC and medm
- The figure below shows the two resulting terminal windows and the Linkam control screen.



- The following parameters can be set (left side):
 - Pump speed for LN2 cooling (optional—this can also be controlled automatically based on the selected cooling rate). Upper limit = 30
 - Rate of temperature change (°C/min)
 - Desired temperature
- Note the control buttons (right side):
 - Scan Disable: tells VME (EPICS sscan) to stop communicating with the controller (e.g. software is loaded but controller is not in use). "Enable" restarts communication.
 - Toggle LNP between automatic & manual
 - Start, hold, or stop heating/cooling

EPICS Software Controls



Select "User Specified," and set the high and low limits. Click "Apply."

To adjust the scale on the Y-axis: right-click, then select "PV Limits."

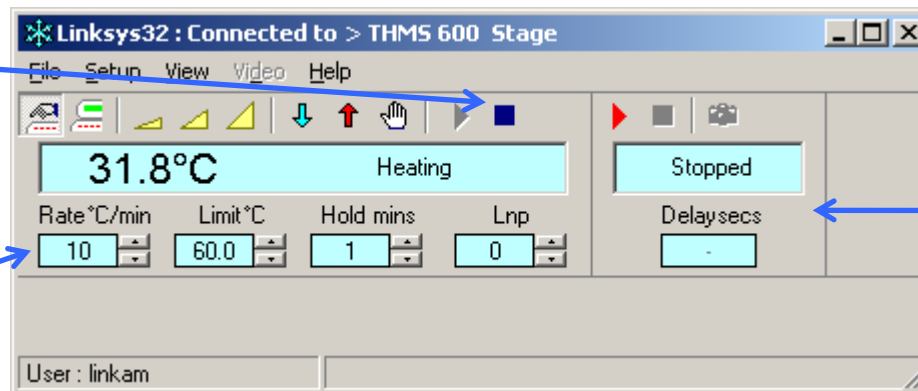
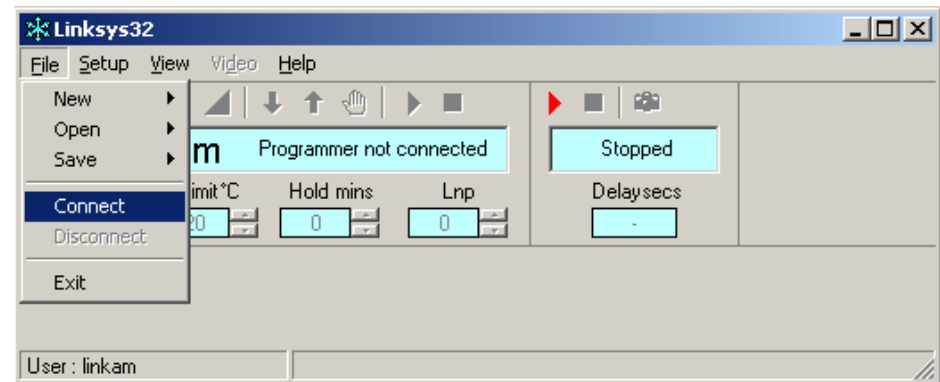
Thanks to John Hammonds for the EPICS interface!

Appendix: Linksys Software Controls

- The Linkam equipment can be controlled with either EPICS or vendor software called Linksys, but not both simultaneously.
 - The Detector Pool no longer supports the Linksys software, but some beamlines may have it installed on their computers.
 - To use the Linkam software, make sure that the EPICS IOC is not running.
- From the desktop, click Linksys32 icon
- Select “File: Connect”



Linksys32lnk



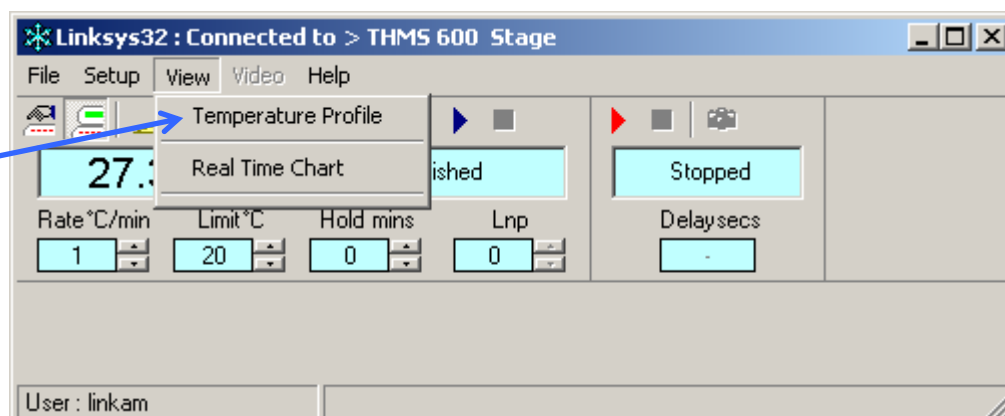
Start and stop temperature ramps

Set the rate, max/min temperature, and hold time here

Data capture controls

Appendix: Linksys Software Controls

Select "View Temperature Profile" to setup multiple-step temperature ramps



A previously-set temperature profile may affect your ability to control the stage. If control difficulties occur, check the temperature profile settings.

Profile				
Profile - Cycle mode off				
Ramp	Rate	Limit	Time	Delay
1	1	20.0	30	-
2	0	0.0	0	-
3	0	0.0	0	-
4	0	0.0	0	-
5	0	0.0	0	-
6	0	0.0	0	-
7	0	0.0	0	-
8	0	0.0	0	-
9	0	0.0	0	-
10	0	0.0	0	-
11	0	0.0	0	-

If you are using the DSC, you may be required to use a Temperature Profile!!!